# Organic Food for Thought

## Lessening Children's Pesticide Exposure

Parents concerned about the risk to their children's health posed by eating foods sprayed with organophosphorus (OP) pesticides may want to take note: Cynthia Curl and her colleagues at the University of Washington compared the OP pesticide metabolite levels of 39 Seattle preschool children and found that children who consumed organic fruits, vegetables, and juices had significantly lower OP pesticide exposure than those who consumed conventional foods [***EHP* 111:377–382**]. They also concluded that consumption of organic produce and juice may shift children's OP pesticide exposure from a range of uncertain risk to a range of negligible risk, as defined by the U.S. Environmental Protection Agency's current guidelines. Studies suggest that chronic low-level exposure to OP pesticides may affect neurological functioning, neurodevelopment, and growth in children.


**Producing healthier kids?** New study shows that eating all or mostly organic goods can help children avoid exposure to organophosphorus pesticide residues, which may be linked with neurological and growth problems.

Consumption of produce and juice is possibly one of the main pathways by which children are exposed to pesticide residues. Children's diets often include more of these items than do adult diets. Children also eat more food per body mass than adults.

The scientists recruited families at a local chain supermarket selling mostly conventional products and a consumer cooperative selling mostly organic goods. Children aged 2–5 years were considered eligible for the study if their parents stated that the produce and juice they consumed was nearly all conventional or nearly all organic. Parents were later interviewed in the home about a variety of topics such as income, length of time at their current residence, and housekeeping practices, as well as any recent use of pesticides around the home, which could present an alternative route of exposure in the children (it was subsequently determined not to be a confounding factor). They were also asked how often their children sucked their thumbs, washed their hands, engaged in hand-to-mouth activity, and spent time outdoors. The parents kept food diaries for their children for three days, and collected as much of the urine produced by their children on the third day as they could. Most parents collected nearly all the urine their children produced.

It was rare for a family to eat 100% organically, so a 75% cutoff was employed: 18 children whose juice and produce servings were 75% or more organic were included in the "organic" category, and 21 children whose diets were 75% or more conventional were grouped into the "conventional" category. The children's urine samples were analyzed for five OP pesticide metabolites: dimethylphosphate, dimethylthiophosphate, dimethyldithiophosphate, diethylphosphate, and diethylthiophosphate. These metabolites can be grouped as dimethyl and diethyl metabolites.

The data showed that the median total dimethyl metabolite concentration was approximately six times higher for the children eating conventional diets than for the children eating organic diets. The median total diethyl metabolite concentration was the same across the two groups. Overall, the children eating primarily organic diets had significantly lower OP pesticide metabolite concentrations than did the children eating conventional diets.

This analysis did not allow the researchers to determine exactly which pesticides children were being exposed to. The metabolites measured are generic breakdown products of more than a dozen OP pesticides, and within that group there is more than a 100-fold difference in toxicity. The researchers did, however, calculate some simple dose estimates, and the results of those estimates suggest that consuming organic products may reduce a child's exposure level to below the Environmental Protection Agency's chronic reference doses for various OP pesticides, shifting exposures from a range of uncertain risk to a range of negligible risk. **–Ernie Hood**

# Cancer and Three Mile Island

## No Significant Increase in Five-Mile Radius

The 1979 accident at the Three Mile Island (TMI) nuclear power plant was the all-time worst at any commercial nuclear power plant in the United States. Small quantities of xenon and iodine isotopes were released during the accident and shortly afterward. Although exposures were later determined to be minimal, the state of the science at the time implicated low-level radiation in cancers and raised fears about increases in radiation-induced cancers among residents living near TMI. However, there has been no statistically significant elevation in overall cancer deaths among people living within a five-mile radius of TMI at the time of the accident, according to a 20-year follow-up study published this month by Evelyn O. Talbott and colleagues from the University of Pittsburgh [***EHP* 111:341–348**].

The study compared deaths among the TMI cohort over the period 1979–1998 to those in both a local population outside of the five-mile radius and Pennsylvania's population as a whole. The team drew their data from the TMI Population Registry, compiled by the Pennsylvania Department of Health. The department had gathered radiation exposure information on 93% of the population living within five miles of the nuclear plant—nearly 36,000 people—in comprehensive door-to-door surveys shortly after the accident.

The radiation exposure data took into account where people were—whether indoors or outdoors, upwind or downwind, and so forth—during the largest exposure on the day of the accident, as well as over the 10 days following the accident, when additional radiation escaped. This allowed scientists to later determine whether each individual had received a low, medium, medium/high, or high dose of

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radiation. Thus, the Pittsburgh researchers were able to compare risk related to an estimated gradient of exposure within the cohort, allowing a more accurate correlation between exposure and health effects.

After the accident, scientists estimated "likely" and "maximum" whole-body gamma radiation doses for the TMI cohort. Individual exposures were estimated to range from 1 to 170 millirems (mrem). The likely dose was estimated to be 9 mrem. The maximum dose—which refers to the worst possible exposure, in which a person would have been outdoors and directly downwind of the plant—was estimated to be 25 mrem. By comparison, a chest X ray is a 10-mrem exposure, but to the chest only. And the average annual background radiation dose in the United States is 300 mrem, according to the Committee on the Biological Effects of Ionizing Radiation (BEIR).

Although the Pittsburgh team found no statistically significant rise in cancer deaths, there was a slight increase in overall mortality among the TMI population, with the deaths due primarily to heart disease. However, the heart disease is not thought to be related to radiation exposure, but rather is most likely due to the population having well-established heart disease risk factors (such as smoking and socioeconomic status) that were not measured. Another possible factor is the stress of living within the plant's shadow following the accident.

The study is particularly important because it is one of only a very few on the health effects of low-level radiation, particularly at these lowest levels of exposure. The study is also valuable for the particularly high integrity of its data: 20-year follow-up mortality data exist for 98.2% of the TMI cohort. The authors recommend, among other things, continued monitoring of the childhood population near TMI and continued follow-up on mortality for the TMI cohort beyond the original cutoff of 31 December 1998, especially as some cancers have a longer latency period. **–David C. Holzman**

# On the Trail of Agent Orange

## Measuring Risk with GIS

As with many environmental health questions, uncovering the true health effects of the herbicides used in the Vietnam War has been limited by problems with assessing exposure. In this issue, Jeanne Mager Stellman of Columbia University's Mailman School of Public Health and colleagues describe a new research tool: software that incorporates relational database technology, geographic information system (GIS) principles, and refined mathematical models to create "exposure opportunity" scores from military data on spray missions [***EHP* 111:321–328**].

Between 1961 and 1971, U.S. forces sprayed nearly 19.5 million gallons of herbicide in Southeast Asia, mostly from fixed-wing aircraft. These herbicides had been contaminated during production with minute amounts of dioxins, by-products of the manufacturing process. Dioxins have been linked with Hodgkin disease, non-Hodgkin lymphoma, soft-tissue sarcoma, and more tentatively with type 2 diabetes mellitus and other conditions.

The GIS divides Vietnam and parts of Laos into a grid of 0.01-degree blocks (about 1.2 kilometers on a side) and contains data on the locations of villages, roadways, bridges, military bases, airfields, and targets, the known movements of U.S. military units, and the 9,141 airborne spraying missions of the U.S. herbicide campaign. The relational database uses mathematical modeling to calculate an exposure opportunity index for a military unit or a location on any date during the war. The index is a relative, not absolute, measure of exposure, says coauthor Steven Stellman; higher scores reflect more gallons being sprayed in an area, being closer to the sprays, and spending a longer time in a sprayed area. The GIS is flexible; researchers can insert other mathematical models to reflect different assumptions, such as how fast the contaminants degrade.

Jeanne Stellman says the new software was developed under contract to the National Academy of Sciences in response to a call by the Agent Orange Act of 1991 for better research. "The academy had found that no systematic study has been done on Vietnam because there was no agreed exposure methodology," she says. "We've been able to refine models and take advantage of new database technologies and GIS concepts [to create an approach that standardizes exposure opportunity]." It will be up to future research efforts to actually apply the new methodology to the health effects of herbicides used in Vietnam.

Nobody is ever likely to calculate exact exposures that occurred more than 30 years ago, so the exposure opportunity index represents a major advance in the quest to understand the effects of Agent Orange. Because some parts of Vietnam were heavily sprayed, while most were never sprayed, the range of relative exposure was huge. Jeanne Stellman says the greatest exposures were about six orders of magnitude higher than those of people who were not near spray zones.

A key to using the new database will be choosing the study population wisely, she says, because location data are better for some military units than others. "If you select a group to study randomly, it will be hard, because it's difficult to reconstruct locations after so many years. If you go for the 'hot spots' and military units with good records [for inputting into the GIS], you'll be able to do a pretty good study." **–David J. Tenenbaum**

**Spraying scenarios.** New software will help scientists calculate an Agent Orange exposure opportunity index for any date and location during the Vietnam War.

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